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The effects of mental imagery on implementation intentions: specifically in regards to exercise goal achievement

Nathan Trethewey

Project advisor: [Jon May](#), School of Psychology, Faculty of Science and Technology, Plymouth University, Drake Circus, Plymouth, PL4 8AA

Abstract

Past research shows that mental imagery can be used to enhance the effectiveness of implementation intentions. The present study aims to expand this, proposing that mental imagery can be used to enhance the effectiveness of implementation intentions specifically in regards to exercise. Results support the hypothesis that when mental imagery is used to enhance the effectiveness of implementation intentions, participants are more likely to meet their exercise goals. Furthermore based on past research it was hypothesized that participants in the implementation intention and mental imagery condition would experience stronger cravings towards exercise however no significant difference between the groups was found.

Introduction

Coronary heart disease (CHD) is one of the leading causes for premature death in modern industrial societies. According to Scarborough, Bhatnagar, Wickramasinghe, Smolina, Mitchell, and Rayner (2010) heart and circulatory disease are the UK's biggest killers. As the report explains people who are physically active are at a lower risk of CHD. This is also shown in a review by Miller, Balady, and Fletcher (1997) where it was found that a physically inactive lifestyle doubles the risk of CHD. Regular exercise can prevent the onset of CHD by lowering blood pressure and reducing blood cholesterol levels. As seen in Bouchard & Despres (1995) this in turn reduces the primary cause of CHD, atherosclerosis where there is a build up of fatty deposits on the artery walls.

As Scarborough et al (2010) explain while physical activity levels have increased in the UK over the past decade they are still relatively low. Furthermore Craig, Mindell, and Hirani (2008) showed that most data obtained about physical activity is self reported, however for this report a sub-sample was selected who wore accelerometers to objectively measure their physical activity levels. Based on the accelerometer data, only 6% of men and 4% of women met the governments recommended amount of physical activity, but according to the self reported levels, 39% of men and 29% of women met these recommendations. This would suggest that physical activity is often over reported by people. Perhaps the most interesting finding is that people feel they partake in reasonable amount of physical activity however in reality this may not be the case. This finding is similar to that found by Sheeran (2002) in the correlation between people's intentions and their actual behaviour. People often have good intentions for example increasing their physical activity, however too often they fail to meet their goals. In the meta-analysis performed by Sheeran (2002) it was found that intentions on average only account for 23% of the variance in behaviour.

Intentions alone also have difficulty to cause long term behaviour change. As can be seen in the context of New Year's resolutions in a study by Norcross, Mrykalo and Blagys (2002). Norcross et al (2002) reported interesting statistics on the top New Year's resolutions and how people actually stick to them. The top three New Year's resolutions regarded weight loss, exercise and stopping smoking. Of the people that made New Year's resolutions 75% maintained them past the first week, 74% past the second week, 64% after one month and 46% after six months. However only 6% of a control group of non resolvers reported being successful after 6 months.

There are many methods that have been examined as predictors of exercise behaviour as shown in a study by Bozionelos and Bennett (1999) where they looked at the predictive capabilities of the theory of planned behaviour. Other variables were also added such as past behaviour, role beliefs, level of self monitoring and sex role identity in relation to intention and behaviour. Another variable was personal norms; these reflect a person's feelings of moral obligation and responsibility when the person has to decide whether to perform a behaviour or not (Triandis 1977, as cited by Bozionelos and Bennett, 1999). It was found that of the variables past behaviour was indeed the best predictor of exercise behaviour.

As Knäuper, Roseman, Johnson and Krantz (2009) explain both mental imagery and implementation intentions have separately been revealed to reduce the variance

between intention and behaviour. Implementation intentions are when the individual commits to specific plans regarding when and where the goal directed behaviour will occur. For example an individual may say that they intend to start the goal directed behaviour X when situation Y occurs (Gollwitzer 1993). A goal intention only states what the individual wants to achieve. Implementation intentions lay down specific plans to promote the execution of specific goal directed behaviour. As Gollwitzer (1993) explains this means that an implementation intention always is used to achieve a goal intention and as such implementation intentions are not formed prior to goal intentions but rather they are formed at the same time or subsequently.

Gollwitzer and Sheeran (2006) performed a meta-analysis to investigate the effectiveness of implementation intentions. They found that implementation intentions had a medium to large effect on goal achievement. This is thought to be due to the psychological processes that are used when forming an "if and then" relationship. As described by Gollwitzer (1999) implementation intentions activate a mental representation of the critical cues involved, this then allows them to be more cognitively accessible. Due to this heightened accessibility it should be easier to detect the critical cues in the surrounding environment and to attend to it when you may be otherwise preoccupied. Furthermore it should be easier to recall when questioned about when or where you are going to start your goal pursuit. However Gollwitzer (1999) explained how implementation intentions also go beyond this and can apply an effective goal directed behaviour, which is then linked to the chosen critical situation. This mental process is what is thought to then cause the goal directed behaviour to be automatically activated when in the chosen critical situation.

Laboratory studies such as that performed by Gollwitzer (1993) demonstrate that participants who have formed implementation intentions show excellent memory for the specific items involved in their intentions, such as location and time the intended behaviour will take place. Furthermore the behaviour is often performed exactly when and where the specifics of the intention dictate, however this also poses a problem. This research suggests that participants rely on certain environmental cues in order to maintain their exercise regime. As such encouraging people to stick to an exercise regime using implementation intentions alone may lead to a reasonably strict intervention. As shown by Gollwitzer (1993) should participants not experience these environmental cues they may not stick to their exercise regime.

Implementation intentions predominantly occur on a conscious level and as such may not be as effective in behaviour change. This is shown in the study by Jackson, Lawton, Knapp, Raynor, Conner and Lowe (2005). The authors looked at how implementation intentions may be less effective when dealing with more complex behaviours such as an exercise regime when compared to more simple behaviours such as taking vitamins in the morning. Jackson et al (2005) found that implementation intentions are less effective when dealing with complex behaviours and work best with less complex behaviours. It is thought that complex behaviours are less amenable to conscious thoughts and as such implementation intentions that focus on conscious processes may be less effective at changing complex behaviour. However combining implementation intentions with mental imagery that acknowledges the unconscious processes may be more successful in behaviour change.

There are many kinds of mental imagery (e.g. visual) but there is also motor imagery, where mental imagery is used in preparation and to execute an action. According to this definition motor imagery has the same properties as the corresponding motor representation (Jeannerod 1994). Mental imagery can be experienced externally as a spectator watching a visual scene in which a motor action is performed. Alternatively they can be experienced internally where you see a first person perspective of performing the motor action (Mahoney and Avenier 1987).

There is much research showing that mental imagery can enhance goal achievement and motivation. One such study is that by Vasquez and Buehler (2007) where they investigated the results of mental imagery and motivation across three separate studies. Their findings suggested that mental imagery can indeed enhance motivation however interestingly this was only found when participants imagined themselves achieving their goal from a third person perspective. It is thought that the people who envisioned themselves being successful from a third person perspective tended to construe their success in a manner that highlighted its broader meaning and significance, whereas this was not the case for people who envisioned their success in a first person perspective. However it is also worth noting that Vasquez and Buehler (2007) found that the motivational impact of the third person imagery did not seem to be primarily due to increased performance goals. Rather the effect appeared to reflect the personal meaning that the participant themselves attributed to their successful completion of the task.

As Vasquez and Buehler (2007) explain there are alternative explanations for why third person mental imagery increased motivation whereas first person did not. One such possibility is that due to participants viewing themselves achieving their goal in third person they are actually subject to a heightened sense of self awareness that is often seen produced by mirrors, video surveillance or having an audience present. (Mullen and Baumeister, 1987, Plant and Ryan, 1985)

Another possible explanation for this effect could be that the third person perspective increased motivation due to causing participants to attribute their success to different things. The third person perspective may cause participants to attribute their success as being due to dispositional factors, such as effort, rather than situational factors such as luck. As such if participants believe that achieving their goal is attainable and down to them, it stands to reason that this would increase motivation. (Vasquez and Buehler (2007).

Anderson and Moss (2011) investigated the effectiveness of both implementation intentions and guided mental imagery specifically as an aid to encouraging exercise. Participants were randomly allocated to one of four conditions (guided imagery, implementation intention, relaxation imagery and a control condition). All participants were encouraged to exercise for the next two weeks and to record exercise activities in a diary. All participants were also given a follow up questionnaire after the two weeks. The participants in the imagery conditions were given either a guided imagery CD or a relaxation imagery CD respectively. Participants in the implementation condition had specific forms included in their diary and the control group was just given the instructions.

The results showed that participants in the guided imagery condition increased their exercise levels the most however it was not significantly more than participants in the

implementation intention group. Both guided imagery and implementation intentions were shown to be effective at increasing exercise levels significantly more than the control group. It is also worth noting that the relaxation imagery group followed a similar activity trend as both the guided imagery and implementation intention groups. Anderson and Moss (2011) propose that this may be due to regular relaxation enabling participants to be more successful in their behaviour change. Alternatively while the relaxation imagery in itself may not have been consciously encouraging exercise it may have reminded participants that they were part of the study. Playing the relaxation CD once a day throughout the study may have reminded participants that they were encouraged to exercise and keep a diary of this, thus they partook in more exercise.

Much of the literature on implementation intentions and mental imagery for the most part are separate however a few recent studies have emerged where both implementation intentions and mental imagery were combined. One such study is that by Knäuper, et al (2009) where mental imagery was used to enhance the effectiveness of implementation intentions. Participants were randomly allocated to one of two conditions. Both conditions were given a mundane goal to complete (picking up 5 dollars from a specified location) however one group was an implementation intention only group (II) the other was implementation and mental imagery (II+MI). Participants in the II group were given instructions to form an implementation to go and pick up the five dollars. Participants in the II+MI group were given the same instructions but were also asked to close their eyes and imagine themselves picking up the five dollars. Knäuper, et al (2009) found that 88% of participants in the II+MI condition turned up to pick up the money whereas only 60% in the II condition turned up. This was found to be statistically significant thus supporting the notion that mental imagery can increase the effectiveness of implementation intentions.

The combination of implementation intentions and mental imagery may enhance goal achievement by increasing craving for the goal behaviour. The elaborative intrusion (EI) theory (Kavanagh, Andrade and May 2005) gives craving a motivational role towards desire. In EI theory, craving thoughts arise from a number of triggers, such as environmental cues and associative stimuli. When these occur outside of awareness, the initial thought is experienced as intrusive or spontaneous. (Berry, Andrade and May 2006). According to EI theory this initial thought will then be elaborated on by the retrieval of memories and also the creation of mental imagery in relation to the target. (May, Andrade, Kavanagh and Penfound 2008). Articulation of the image is enhanced by the retrieval of additional information from memory, elicitation of anticipatory somatic reactions such as salivation and also by additional cues encountered as the target is approached (May, et al 2008). This greater articulation of imagery leads to greater motivational power. As such according to EI theory a greater degree of imagery should be associated with a stronger craving, and a weaker degree of imagery should be associated with a weaker craving.

This was investigated specifically towards exercise behaviour (field hockey) in May et al (2008). Physical activity has been widely shown to be compelling Hausenblas and Symons Downs (2002 as cited in May et al, 2008), and as such EI theory should be able to help explain cravings felt for exercise. It was found that cravings, both

strong and weak were associated with the presence of imagery, spontaneous thoughts and anticipated reward and relief from completing the desire (May et al 2008). Therefore if imagery is shown to be related to strength of craving it stands to reason that mental imagery would enhance the effectiveness of implementation intentions by increasing the craving for the desired activity through EI theory.

Based on the findings by Knäuper, et al (2009) as well as that of Anderson and Moss (2011) the present study aims to explore whether the use of mental imagery can enhance the effectiveness of implementation intentions specifically in regards to exercise behaviour. As Knäuper, et al (2009) explain what is unique to mental imagery is that multiple sensory inputs are used to form mental representations of objects, situations and goal directed actions. By using multiple sensory inputs a more realistic representation of actual stimuli and actions should be formed thus resulting in stronger memory traces.

Implementation intentions primarily use verbally based cognitive processes since it relies on forming a verbal if-then statement. As shown by Knäuper, et al (2009) combining both mental imagery and implementation intentions increases goal achievement more than just the implementation intentions alone. The rationale behind this is that the mental imagery component should make people even more 'perceptually ready' for action (Neisser 1978, as cited by Knäuper et al, 2009). This is because the mental imagery adds rich multi-sensory information to the mental representation activated by the implementation intention and as such should leave the critical cues more cognitively accessible. According to Knäuper, et al (2009) this would then lead to heightened sensory sensitivity to the critical situation thus leading to higher goal performance.

Furthermore as seen in Anderson and Moss (2011) when used separately both implementation intentions as well as guided imagery caused an increase in exercise behaviour, significantly more than that of the control group who were not subject to either condition. With this in mind the present study aims expand on these findings, investigating whether combining mental imagery with implementation intentions will have a greater effect on exercise behaviours than implementation intentions alone. The present study combines the studies conducted by Knäuper, et al (2009) and Anderson and Moss (2011) by not only combining implementation intentions and mental imagery as seen in Knäuper, et al (2009). But the present study will also apply them specifically to exercise behaviour much like what was seen in Anderson and Moss (2011).

Based on previous studies that have been conducted on implementation intentions and mental imagery the aim of the present study is to investigate the effect combining mental imagery with implementation intentions has on goal achievement, specifically in regard to exercise behaviour. In the present study participants were asked to report how much exercise they had completed this week and how much they aim to complete next week. Whether participants met their exercise target they set the week before was investigated as well as craving strength. Participants were assigned to either an implementation only group (II) or implementation and mental imagery group (II+MI). The implementation intervention would operate on a predominantly conscious level and should prompt behaviour through environmental cues that were specified when forming the implementation intention. Mental imagery

on the other hand operates on a predominantly pre-conscious level and should allow the associations between cues and behaviour to be more deeply processed. With this and previous results from past studies in mind, the hypothesis of the present study is that participants in the II+MI group would meet their exercise goals more often than the participants in the II group only. Furthermore participants in the II+MI condition would show greater craving towards exercise.

Method

Participants

The participants were university students currently studying psychology at Plymouth University. They participated in the study in order to get a point which they could then use to reward volunteers for their own research. Thirty-six participants (29 female, 7 male; Age range 18-44) completed the first week's questionnaire, with nineteen (17 female, 2 male; age range 18-30) completing all five weeks questionnaires.

Materials

The materials used for this study were all presented online, including an online brief (Appendix A), online debrief (Appendix B) and online questionnaires (Appendices C - F). The brief stated that participants had the right to withdraw at any time and would still receive participation credit. It also described what the participants would be doing. The debrief also reminded participants that they could still withdraw their results if they wished while also describing the rationale behind the study. Some example questions from the questionnaires include "How many times have you participated in exercise since the last questionnaire?" and "How many times will you participate in exercise before the next weekly questionnaire?" A modified CEQ was also included in the weekly questionnaire where participants were asked to "Think back to the strongest craving you have had for exercise this past week, and answer these questions on the scale running from 'not at all' to 'extremely'." An example question would be "how strong was the urge to exercise?"

Procedure

The study used a between subjects design. Participants signed up through the School of Psychology participation pool. Upon signing up to the study participants were presented with the brief and asked to complete the first questionnaire, after ticking a box providing informed consent saying they have read the brief and want to proceed with the study. They were then asked to give their sex and date of birth, and were randomly allocated to either an imagery, or a verbal condition.

All participants were asked to record how much exercise they did since the last questionnaire and how much they planned to do next week before the next questionnaire. They were then asked to form an implementation intention about performing exercise in the next week, by writing in a text box when, where and how they would complete the exercise. An example of this was given, to show that their first exercise activity of the week could be Monday at 11am, in the university gym and they would get there by walking via the student union.

Participants in the imagery condition were then asked to close their eyes and imagine doing the exercise activity at the place and time that they had wrote down.

Furthermore they were asked to imagine how they would feel when they have completed the exercise knowing that they are one step closer to their ultimate goal.

Participants in the verbal condition were asked to rehearse the intention by reading it aloud three times, focusing upon the sound of their voice as they did so.

They were then asked to complete a one page form each week for four subsequent weeks, in which goal achievement was measured by whether or not the participants met the exercise expectations that they had set themselves the week before.

Participants also completed a modified CEQ in order to measure the strength of craving towards exercise they felt during the week. Every week they were sent an email reminder with a link to that week's form. After the final week, they were emailed a debriefing letter and thanked for their participation.

Results

Over the course of the five weeks the mean activity level for the II+MI condition was 2.59 (SD=.52) times per week with the mean intended activity being 2.93 (SD=.54) times per week, whereas in comparison the mean activity level for the II condition was 2.40 (SD=.67) with the mean intended activity being 2.9 (SD=.65) times per week (Table 1).

Table 1: Condition means and standard deviation

Condition	Mean Activity level	Activity SD	Intended activity level	Intended activity SD
II+MI	2.59	.52	2.93	.54
II	2.40	.67	2.90	.65

Table 2: Condition means and standard deviation separated by week

		Week 0	Week 1	Week 1	Week 2	Week 2	Week 3	Week 3	Week 4	Week 4
		actual activity	intended activity	actual activity	intended activity	actual activity	intended activity	actual activity	intended activity	actual activity
II+MI	Mean	2.11	3.00	2.74	3.00	2.80	3.07	2.69	2.94	2.64
	N	19	19	19	19	15	15	16	16	14
	SD	.77	.67	.81	.75	.94	.70	.87	.68	.50
II	Mean	2.24	3.06	2.44	3.06	2.36	3.27	2.62	2.75	2.43
	N	17	17	16	16	11	11	16	16	14
	SD	.97	.75	.73	.77	.81	.79	1.03	.86	.94

As shown in Table 2, the mean activity for each week was consistently higher for the II+MI condition, with the exception of week zero where the mean activity was slightly higher for the II condition. The mean activity level peaked for the II+MI condition in week two at 2.80 times per week, whereas for the II condition the mean activity level peaked in week three at 2.62 times per week. The mean intention peaked for both the II+MI and II conditions in week two (3.07 and 3.27 times per week respectively). This then decreased for the subsequent weeks.

Figure 1 displays the mean intention levels next to the mean activity levels while being grouped by condition. From looking at the bar chart it looks as though there is less variance between intended activity and actual activity for the II+MI condition.

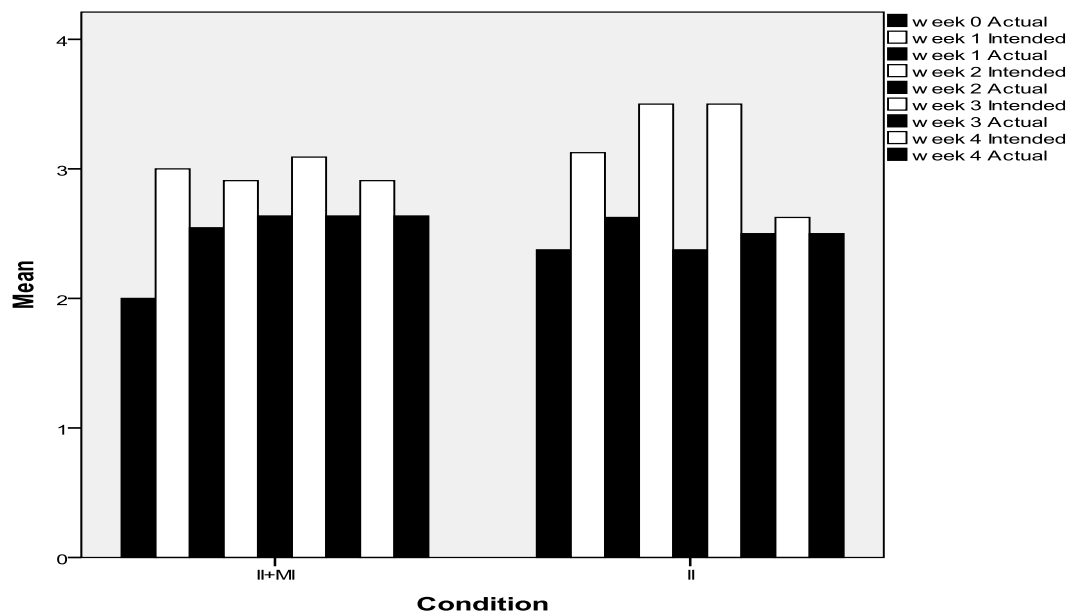


Figure 1: Actual activity levels compared with Intended activity levels

Table 3: Condition with example intentions formed

Condition	Example Intention
II+MI	On Monday at 9am at home on the cross-trainer Running, embankment route, with my housemate at about 5pm. Tuesday 3pm at the University gym Thursday at 2pm at home, using my Nintendo wii fit.
II	Monday 8am go for a jog to central park Monday evening, going for a run at 6pm down to the barbican Monday 10 am, Morgan's gym, walk from house via campus Thursday at 6.30pm at a local school to a dance class

Table 3 shows the range of intentions formed and some of the exercise activities that accompany them. As you can see there is variety of different intentions formed with different actives. They range from using the "Nintendo wii fit" to attending a "dance class".

In order to test the hypothesis that that participants in the II+MI group would meet their exercise goals more often than the participants in the II group a one-way analysis of covariance (ANCOVA) (SPSS 19.0) was conducted for this study on each week individually. Each week had to be analysed separately due to SPSS limitations. For all weeks the Independent variable, condition, included two levels: II+MI or II only.

For the first ANCOVA the dependent variable was the participant's week one activity levels and the covariate was the participant's week zero intended activity. A preliminary analysis evaluating the homogeneity-of-regression (slopes) assumption indicated that the relationship between the covariate and the dependent variable did

not differ significantly as a function of the independent variable, $F(1, 31) = .95, p = .337$. The ANCOVA was not significant, $F(1, 32) = 1.83, p = .186$ partial $\eta^2 = .054$. That is 5% of the total variance in week one's activity level was accounted for by the condition (II+MI or II only) controlling for the effect of week zero's intended activity.

For the second ANCOVA the dependent variable was the participant's week two activity levels and the covariate was the participant's week one intended activity. A preliminary analysis evaluating the homogeneity-of-regression (slopes) assumption indicated that the relationship between the covariate and the dependent variable did not differ significantly as a function of the independent variable, $F(1, 22) = 1.72, p = .204$. The ANCOVA was significant, $F(1, 23) = 5.56, p = .027$ partial $\eta^2 = .20$. That is 20% of the total variance in week two's activity level was accounted for by the condition (II+MI or II only) controlling for the effect of week one's intended activity.

For the third ANCOVA the dependent variable was the participant's week three activity levels and the covariate was the participant's week two intended activities. A preliminary analysis evaluating the homogeneity-of-regression (slopes) assumption indicated that the relationship between the covariate and the dependent variable did not differ significantly as a function of the independent variable, $F(1, 18) = .02, p = .891$. The ANCOVA was not significant, $F(1, 19) = .41, p = .532$ partial $\eta^2 = .021$. That is 2% of the total variance in week three's activity level was accounted for by the condition (II+MI or II only) controlling for the effect of week two's intended activity.

For the fourth ANCOVA the dependent variable was the participant's week four activity levels and the covariate was the participant's week three intended activities. A preliminary analysis evaluating the homogeneity-of-regression (slopes) assumption indicated that the relationship between the covariate and the dependent variable did not differ significantly as a function of the independent variable, $F(1, 24) = 3.38, p = .078$. The ANCOVA was not significant, $F(1, 25) = .006, p = .939$ partial $\eta^2 = .000$. That is 0% of the total variance in week four's activity level was accounted for by the condition (II+MI or II only) controlling for the effect of week three's intended activity.

A one way analysis of variance (ANOVA) (SPSS 19.0) was also conducted in order to test if there was a significant difference between the participant's intentions. The ANOVA was not significant at the $p < .05$ level. $F(1, 34) = .029, p = .865$ partial $\eta^2 = .001$.

Table 4: CEQ mean responses and standard deviations

Condition		Craving strength	How vividly did you imagine exercising?	How vividly did you picture yourself exercising?	How vividly did you hear yourself exercising?	How vividly did you imagine what it would feel like?
II+MI	Mean	6.44	5.63	5.31	3.07	5.22
	SD	1.79	2.13	2.19	2.61	2.34
II	Mean	5.34	3.96	3.76	2.10	3.87
	SD	2.47	2.86	2.80	2.24	2.90

Table 4 shows the descriptive statistics comparing the means across the groups for the various CEQ items. As you can see the II+MI condition experienced stronger cravings for exercise over the course of the questionnaire with a mean craving of 6.44 compared to 5.34 for the II condition. Furthermore when looking back to on their strongest cravings the MI+II condition also experienced a higher mean intensity of imagining themselves exercising, picturing themselves exercising, hearing themselves exercising and feeling themselves exercising.

Furthermore in order to test the hypothesis that participants in the II+MI condition would show greater craving towards exercise participants completed a CEQ asking them to look back on the strongest craving for exercise they had for the past week. The first 3 items were grouped as strength of craving ("How strong was the urge to exercise?" "How much did you feel you needed to exercise?" and "How strongly did you want to exercise?") An ANOVA (SPSS 19.0) was conducted to compare the effect of condition (II+MI or II only) on mean CEQ craving scores. The ANOVA was not significant at the $p < .05$ level. $F(1, 34) = 2.384$, $p = .132$ partial $\eta^2 = .066$.

The rest of the CEQ items were analysed separately. An ANOVA was conducted to compare the effect of condition (II+MI or II only) on mean CEQ imagining exercise scores. The ANOVA was not significant at the $p < .05$ level. $F(1, 34) = 4.00$, $p = .054$ $\eta^2 = .105$.

A second ANOVA was conducted to compare the effect of condition (II+MI or II only) on mean CEQ picturing exercise scores. The ANOVA was not significant at the $p < .05$ level. $F(1, 34) = 3.44$, $p = .072$ $\eta^2 = .092$.

A third ANOVA was conducted to compare the effect of condition (II+MI or II only) on mean CEQ hear exercise scores. The ANOVA was not significant at the $p < .05$ level. $F(1, 34) = 1.42$, $p = .241$ $\eta^2 = .040$.

A fourth ANOVA was conducted to compare the effect of condition (II+MI or II only) on mean CEQ feel exercise scores. The ANOVA was not significant at the $p < .05$ level. $F(1, 34) = 2.39$, $p = .131$ $\eta^2 = .066$.

Discussion

Initial analysis of the results looking at descriptive statistics would suggest that participants in the MI+II condition were more consistent at meeting the exercise intentions they had set themselves the previous week. An ANCOVA showed that there was a significant effect of condition on week two's activity level when using the previous weeks intended activity level as a covariate. This supports the hypothesis that participants in the II+MI group would meet their exercise goals more often than the participants in the II group. That is to say that in week two participants in the II+MI condition were significantly better at meeting the exercise goals they had set themselves the previous week compared to the II only condition. This result would support past research such as Knäuper, et al (2009) where participants in the II+MI condition showed greater goal achievement than the II only condition.

This effect however was not found for any of the other weeks, for the other weeks there was no significant difference between the conditions in relation to them meeting the exercise goals they had set themselves the previous week. However the

fact that there was a significant difference found for week two still supports the hypothesis and previous research.

Due to the nature of the study there was no need to test activity level at week one since the intervention only occurred after week zero when the initial questionnaire was completed. As such when the exercise intentions of the previous week are taken into account these intentions would have been made before the intervention occurred and participants were subject to the II+MI or II only condition. The first time the participants exercise intentions for the next week are measured after the intervention is at week one. This would explain why the significant difference is found for week two's activity level when account for the previous weeks intentions.

The reason why there was no significant difference found at week three and 4 can also be explained. At this point it has been 3 and 4 weeks respectively since the intervention occurred. As such the effect may be beginning to wear off which could explain why the results get less significant as the weeks go on.

This could be due to a number of reasons, as said above it could be that the added effect of mental imagery cannot be sustained for more than 2 weeks. Alternatively due to the very nature of longitudinal studies there is some participant drop off. This meant that an already small sample size became even smaller and could help to explain why there was a significant difference found at week two but not in the subsequent weeks.

Furthermore another issue with the method of a longitudinal study was that participants were reminded that they can withdraw from the study at any time and would not be penalized for doing so. This meant that participants from either condition could simply drop out or not complete that week's questionnaire if they had not met their exercise goals for that week. This could result in a skew in the data in which participants were more likely to complete the questionnaire if they had met their intentions. This could explain why there was not a significant difference between the conditions since the participants partaking in the questionnaire each week may only be the ones that met their intentions.

There was an attempt to control this extraneous variable in the methodology of the study by making it an online study therefore participants had anonymity and reassurance that they were not going to be personally judged. However the anonymity aspect of online studies also has its draw backs. It is possible that if participants have a particularly bad week they could show participant bias and answer the questionnaire however they feel like and say that they met their intentions when in fact they did not.

In the study by Knäuper , et al (2009) this would not have been as issue as goal achievement was measured by the researchers rather than the participants themselves, therefore the researchers could just count how many participants turned up to collect the reward for each condition. Also in Knäuper, et al (2009) participants had extra motivation to towards their goal since the goal itself was to pick up 5 dollars. However in the present study the only motivation towards their goal was their own ambition towards exercise. In Knäuper, et al (2009) participants will always have the motivation of the 5 dollars however in the present study participants goals may have changed resulting in lower motivation towards exercise regardless of the treatment condition.

Further evidence that implementation intentions can be enhanced by mental imagery is that the present study supports the findings of previous studies such as Knäuper, et al (2009) even though the methodology of the two studies was very different. The present study differs from that of past studies such as Knäuper, et al (2009) in that precautions were taken to ensure that participants spent a similar amount of time on the task, between the conditions. This was achieved by asking participants in the implementation only condition to read aloud the implementation intention they have performed. By doing this participants now spent the same amount of time thinking about the task as did participants in the mental imagery and implementation condition. In the procedure of Knäuper, et al (2009) however participants in the II+MI condition were given the same instructions as the II condition but with an extra mental imagery section where participants were asked to imagine the implementation intention. That is when, where and how they would go about collecting the 5 dollars and how they would feel when the critical cues (time/day/context) arises (Knäuper, et al 2009). The result is that participants in the II+MI condition spend far longer on the task at hand than the II only condition. As such participants in the II+MI condition have had more exposure to the critical cues and cue-response link, this could be one of the reasons participants in the II+MI condition showed better goal achievement. However Knäuper, et al (2009) pointed out that this was a potential limitation in their original study so in the present study this was taken into consideration and there was still a significant difference found at week two even though it was not found in subsequent weeks.

The fact that mental imagery was shown to enhance implementation intentions is also in line with the findings of Anderson and Moss (2011) where it was found that both guided imagery and implementation intentions increased exercise activity more than the control group. Therefore it can be expected combining both mental imagery and implementation intentions would have a greater effect than implementation intentions alone, as was shown in the present study. This is especially the case when Anderson and Moss (2011) found that guided imagery alone increased exercise levels more than implementation intentions however not significantly so.

The hypothesis that participants in the II+MI condition would show greater craving towards exercise was also tested. An ANOVA was conducted to compare the effect of condition (II+MI or II only) on mean CEQ craving scores. Participants in the II+MI condition did show higher a higher mean strength of craving than the II only condition however the ANOVA showed the effect was not significant. This shows that participants in the II+MI condition did not experience significantly stronger craving towards exercise than participants in the II only condition. Therefore we fail to reject the null hypothesis that there is no significant difference between the conditions in relation to strength of craving to exercise. Furthermore if craving had increased for the II+MI condition during craving participants in the II+MI condition should be more prone to imagining exercise, picturing themselves exercising and feel themselves exercising more. However there was no significant effect of condition found on any of these. Participants were also asked if they experienced hearing exercise and it was also found not to be significant however this is as expected.

According to EI theory and past research such as May et al (2008) the added effect of mental imagery should have led to the II+MI condition experiencing stronger cravings than the II only condition. While participants in the II+MI condition did experience stronger cravings towards exercise there was no significant difference

found among the groups. Furthermore there was no significant difference found between the other items such as imaging exercise, picturing exercise and hearing exercise.

One of the reasons a significant difference for strength of craving towards exercise was not found in the present study as it was in May et al (2008) could be due to differences in the way cravings were reported. In the study by May et al (2008) participants were asked to carry around the questionnaire with them and fill it in as soon as they experience craving towards exercise and rate how strongly this was felt. This meant that participants were rating the craving as they were experiencing it. However in the present study participants were asked to look back on the strongest craving they had felt during the week and then asked to rate it. As such participants were unlikely to be rating the craving they felt at that particular time. This meant that not only would they no longer be feeling a strong craving for exercise but they also may miss remember how strong the craving was and rate it weaker than it was felt at the time. This could help explain why the added mental imagery did not seem to increase craving significantly while participants in the II+MI condition were still significantly better at meeting their exercise goals in week two.

While for the most part the results of the present study showing that mental imagery can enhance implementation intentions supports past research, it does differ slightly to the results Vasquez and Buehler (2007) found. While Vasquez and Buehler (2007) did find that mental imagery can increase motivation towards goal achievement, this effect was only found when mental imagery was used in third person and not in first person. However in the present study the mental imagery instructions were presented in first person. This finding could suggest a number of things, one being that when combined with implementation intentions it is simply no longer necessary for the mental imagery to be in third person and first person mental imagery will suffice enough to enhance the effectiveness of the implementation intention. Or alternatively first person mental imagery may enhance implementation intentions but not primarily enhance motivation. This would also explain why there was no significant difference found between exercise intention levels. If the added mental imagery component had caused motivation to be increased significantly then participants in the II+MI condition should have had significantly greater intentions to exercise. However even with this in mind it is worth noting that motivation could have still been increased and just displayed in different ways such as being the reason behind participants in the II+MI condition being significantly better at meeting their exercise goals the previous week, even though their intentions did not differ.

The findings of this study that mental imagery can be used to enhance implementation intentions specifically towards exercise can be directly applied to the general public wishing to increase their exercise behaviour. As previously stated by Miller et al (1997) leading a physically inactive lifestyle doubles the risk of CHD, and according to Scarborough et al (2010) physical activity levels are still relatively low. This could be due to a number of factors but as Norcross et al (2002) show the top three New Year's resolutions regarded weight loss, exercise and stopping smoking, yet even after the first week only 75% of people stick to them. This shows that people want to become healthier and participate in exercise but all too often they fail to achieve the goal they have set themselves and fail even in the first week. The finding that mental imagery can enhance implementation intentions can be used as

an intervention to help encourage these people to keep exercising and meet their goals more often.

Past research such as Anderson and Moss (2011) already shows that mental imagery and implementation intentions separately can help goal achievement specifically in regards to exercise. Studies such as Knäuper, et al (2009) show how mental imagery can enhance implementation intentions, however the present study combines and expands on these findings from previous studies showing how mental imagery can enhance implementation intentions specifically in regards to exercise. This means that an intervention measure using both mental imagery and implementation intentions can be developed and aimed specifically towards increasing exercise goal achievement. The present study has shown how even just spending approximately five minutes forming an implementation intention and then enhancing this with mental imagery can help people meet the exercise goals they set themselves.

However there were some limitations to the present study. For one there was no set definition of exercise to be carried out. As can be seen in table 3 showing some typical implementations formed there is a great variety in the types of exercise the participants performed. While variety is a good thing what this could mean is that some participants exercise activity is much easier than others and as such they may have an easier time sticking to their exercise goals. Furthermore as previously mentioned since it is a self report measure of people's exercise they may not have been truthful while answering and they may have shown demand characteristics. This could have resulted in unreliable data with some participants saying they had met their exercise goals when in actual fact they did not. This is a limitation with many self report studies however even with this said since two distinct groups are being compared, rather comparing each participant with a baseline score, if some participants were untruthful when reporting their exercise activity hopefully it would be the same across both groups and thus would not have a large effect. This however may not have been the case.

In future studies these limitations could be overcome by actually gathering participants together and having them partake in an exercise class and recording attendance each week. This would mean that all participants would be performing the same exercise activity with the same difficulty level for all participants. So if participants do meet their exercise goals and attend the exercise class while others do not it will not be because their exercise activity requires less effort and is easier to stick to. This would also solve the limitation of participants reporting that they had completed the exercise when they had not since a register could be taken at the class to compare attendance. However this method would also come with its own limitations, for one it would require much more resources than the present study. Furthermore participants may be less likely to sign up for the study if they know that they are going to be exercising in front of other people in a controlled setting due to embarrassment or other issues. Lastly another limitation of using exercise classes to gauge participants exercise activity is that the class itself may be motivation to turn up. Participants may encourage each other to come to the class next week; also participants may simply turn up to the class because they know attendance is being recorded. This would mean that rather than participants attending due to the intervention of implementations and mental imagery they may instead be using the

class itself as motivation thus there would be issues in what the study is actually measuring.

Since apart from the present study there is little research currently looking at exercise and implementation intentions enhanced with mental imagery, some future research could be conducted in the same area. The present study showed that the II+MI condition significantly met their exercise goals more often than the II only group at week two however this effect was not found in subsequent weeks. Therefore it would be interested to see using the intervention method of implementation intentions enhanced with mental imagery every week produced a reoccurring significant difference for subsequent weeks and how long this effect would last. Comparing one group who had the intervention each week to a separate group who received the same intervention but only at the start of the study would allow researchers to see if repeated interventions maintained the effect for longer. Or alternatively if the groups do not differ significantly on their exercise goal achievement then this would suggest that repeated interventions are no more effective than only one at the beginning of the study.

Also another area of interest would be using a similar procedure to the present study but having another II+MI condition where the imagery instructions differ in that they are third person imagery. It would be interesting to then see if these results support that of Vasquez and Buehler (2007) in that third person mental imagery enhances motivation whereas first person does not.

In conclusion the present study shows that mental imagery can be used to enhance the effectiveness of implementation intentions specifically towards exercise. These results support the findings of past research such as Knäuper, et al (2009) and Anderson and Moss (2011). However unlike EI theory and past research such as May et al (2008) suggest, participants in the II+MI condition did not experience significantly stronger cravings than the II only group. The present study has real life validity as a means to help the public meet their exercise goals and increase their activity levels thus helping to lower the risk of CHD. While the present study does show how a implementation intention+ mental imagery intervention could be used to help exercise goal achievement there is still plenty of room for further study in the area and how this intervention can be improved.

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Appendices for this work can be retrieved within the Supplementary Files folder which is located in the Reading Tools menu adjacent to this PDF window.